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DESCRIPTIONS OF THE MATURE LARVA AND PUPA OF *HYPOMECIS UMBROSARIA* (HÜBNER) (LEPIDOPTERA: GEOMETRIDAE)[1]

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Abstract.—The mature larva and pupa of *Hypomecis umbrosaria* (Hübner) are described and illustrated. A comparison is made with related genera. What appear to be the first known larval defensive glands in a geometrid are also described, and brief internal morphological studies are included.

The bivoltine *Hypomecis umbrosaria* (Hübner) (Fletcher, 1979), formerly known as *Pseudoboarmia umbrosaria* (Hübner), ranges from coastal Massachusetts to central Florida, west to eastern Texas and north through Arkansas to central Missouri (Rindge, 1973; Heitzman, 1973). *Hypomecis gnopharia* (Guenée) is a sibling species only distinguishable by slight differences in wing pattern and genitalia. The brief larval description of *H. gnopharia* by Guenée (1857), revealed at least no superficial differences from *H. umbrosaria*. The synonymy of these two species is confused, resulting in numerous questionable host records, i.e., horse chestnut, birch, elm, and various conifers (Rindge, 1973).

Hypomecis is a Holarctic genus represented by five species. A single Palearctic species *H. punctalis* (Scopoli), is found from Japan to western Europe, and four Nearctic species occur in eastern and southeastern United States (Rindge, 1973). This genus has affinities to the more primitive members of the Boarmiini, a large worldwide tribe with 34 Nearctic genera. The larval and pupal stages have been studied in many of the related genera, e.g., *Anavitrinella, Anacamptodes, Iridopsis, Glena, Stenoporpia,* and *Cleora* (McGuffin, 1977). The purpose of this paper is to describe the diagnostic morphological characters of the mature larva and pupa of *Hypo-*

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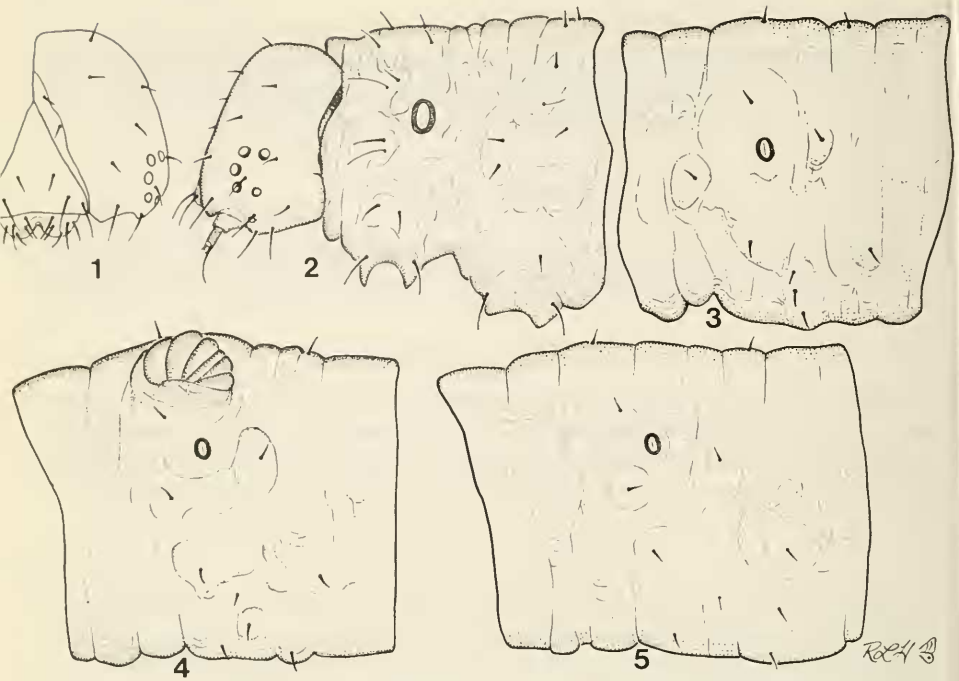


Figs. 1–5. *Hypomecis umbrosaria,* mature larva, 25×. 1, Frontal view of head. 2, Lateral view of head, pro- and mesothorax. 3, Lateral view of abdominal segment 1. 4, Lateral view of abdominal segment 2. 5, Lateral view of abdominal segment 3.

mecis umbrosaria (Hübner) and compare these characters with those of related genera.

Materials and Methods

Four mature larvae and two pupae of *Hypomecis umbrosaria* were examined. These were reared on a leaf diet of mixed *Quercus* species from a female (voucher specimen number: GVS-77-25) collected at the Ashland Wildlife Area, near Columbia, Boone Co., Missouri, June 2, 1977. All specimens were preserved on August 7, 1977. Descriptions and drawings are based on these specimens. A WILD M5 microscope and drawing tube attachment were used in making the illustrations. Measurements are based on the average of the available specimens.

Description of Mature Larva and Pupa

Larva.—*Head:* Height, 2.0 mm; width, 2.7 mm; color reddish brown with areas of dark brown composed of irregular spots located principally above level of ocelli; cuticle heavily granular; ocelli 1–3 largest, 4–6 smaller (Fig.

2); mandibular teeth rudimentary, upper ental surface deeply concave (Fig. 9); labrum moderately bilobed (Fig. 1); epipharynx with inner pair of heli smallest; spinneret short (Fig. 11); postmentum setae short (Fig. 11); maxilla with proximalmost seta longest (Fig. 11).

Body: Length, 35 mm; width 3 mm; mottled in shades of reddish brown; integument finely granular with small, variable, 5- or 6-sided sclerotized, miniature volcano-shaped structures (Fig. 8); most setae short, dark brown, arising from small, black chalazae. Dorsal view: Large areas of light color variably occur at intersegmental folds; prothoracic shield concave on margin above SD setae (Fig. 2); pair of large, wrinkled, invaginating glands on A2 located between D_1 and SD_1 setae (Fig. 4), examination of internal morphology of gland reveals attachment of 5 circular and 2 longitudinal muscles, 1 branching tracheal trunk, and 3 glandular ducts (Figs. 12, 13); A8 with D1 setae on small, black tubercles; anal plate triangular (Fig. 10). Lateral view: Large areas of light color variably occur about spiracles; A6 proleg paler than body; spiracles vary in size, in the following order of decreasing magnitude—T1, A8, A7, A1, and A6, but those on 2–5 of uniform size; peritreme black, spiracular valve pink; hypoproct and paraprocts of about equal length, extending beyond tip of anal plate. Ventral view: Elongate patches of light color centrally located on abdominal segments; thoracic leg bases increasing in size by twice that of preceding segment; thoracic leg bases increasing in size by twice that of preceding segment; thoracic leg claw dark brown (Fig. 14); crochets biordinal and complete (not reduced in size in middle), 38–42 in number on ventral proleg, 49–51 in number on anal proleg.

Chaetotaxy: 5 SV setae on A6 proleg; L1 of A1 at level of top of spiracle (Fig. 3); D1 of A3 (Fig. 5) further anterior than on A1 or A2 (Figs. 3,4); L1 of A7 at level of top spiracle; SV1 seta 3 × length of L1 on A7–9; anal proleg with CD2 closer to level of LG3 than LG2; CP1 and CP2 just above levels of LG2 and LG1, respectively.

Pupa.—*Body:* Height, 15 mm; width, 5 mm.

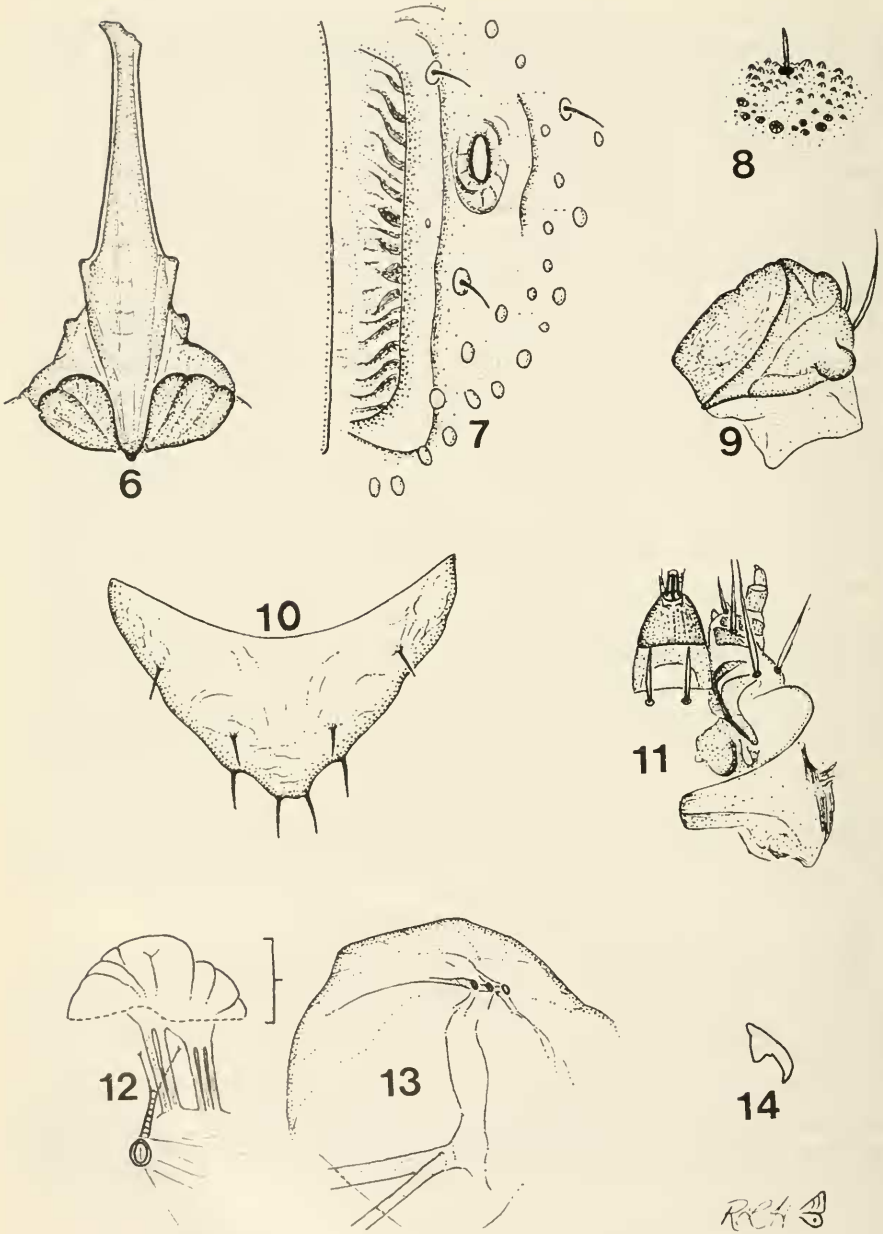
Head: Color dark reddish brown; epicranial suture absent.

Thorax: Wings dark brown, rest variable shades of reddish brown; prothoracic femur not exposed; large, slightly elliptical, pubescent callosities present, ½ size of eyes.

Abdomen: Color dark reddish brown, paler at interfolds; cuticle densely punctate (Fig. 7), setae arising from sunken pits (Fig. 7); A5 with ridged, prespiracular groove (Fig. 7); dorsum of A9 with 4 small, widely spaced teeth on caudal edge. cremaster elongate, blunt-tipped with 4 small, lateral flanges (Fig. 6).

Discussion

The pair of glands on A2, which almost certainly play a defensive role, are of special interest because they apparently have never before been re-



Figs. 6–14. *Hypomecis umbrosaria*. 6–7, Pupa, 50×. 6, Ventral view of cremaster. 7, Right prespiracular furrow on abdominal segment 5. 8–14, Mature larva. 8, Enlargement of cuticle, 50×. 9, Inner view of left mandible, 50×. 10, Anal plate, 25×. 11, Ventral view of mentum, hypopharynx, labial palpi, spinneret and maxilla, 25×. 12–13, Gland on abdominal segment 2

ported to occur in the Geometridae. The closely related *H. gnopharia* possesses the glands also, and Forbes (1948) noted that the penultimate larva of *H. buchholzaria* (Lemmer) has much reduced "warts" at these gland sites. Of the related genera treated by McGuffin (1977), all but *Cleora* include species with one or more protuberances on each side of the second abdominal segment. Except for those of *Anavitrinella pampinaria* Guenée, however, all of these protuberances are tipped with setae, usually the L1 or D2 seta. On *A. pampinaria* the protuberances appear as considerably smaller versions of the glands found on *Hypomecis umbrosaria* as they also lie between the D1 and SD1 setae; however, they are yet to be examined.

In all related genera (based on McGuffin, 1977), the SV4 and SV1 setae on the first abdominal segment are above or above and posterior to the V1 seta, and the L1 seta is at the bottom of the spiracle except in *Anavitrinella*, *Anacamptodes*, and *Iridopsis* (three closely related genera). In *Hypomecis umbrosaria* the SV4 and SV1 setae are above and anterior to the V1 seta and the L1 seta is near the top of the spiracle. Only the L1 of *Anavitrinella* does not correspond to these character states, though it is higher in *Hypomecis umbrosaria* than in the other two genera. In *H. umbrosaria* on the first abdominal segment the L2 seta, second segment the SV4 seta, and third segment the D1 seta are all located further anterior on their respective segments than in any related genera.

The anal plate of *H. umbrosaria* is unusual in lacking a median notch or furrow on its anterior edge. The shape of the plate is similar to many genera but identical to none. The tip of the plate is strongly truncate and the setae are short.

The pupal cremaster is unique for the tribe. Nearly all species have an obvious bifurcation resulting from a deep median groove on the cremasteral tip and lack lateral flanges. The cremaster of *Anavitrinella pampinaria* resembles a distorted, shortened variant of that found on *Hypomecis umbrosaria* in that it possesses three pair of semi-circular ridges that appear homologous to the basal humps and lateral flanges of *H. umbrosaria*. Some species of *Anacamptodes* have a single pair of lateral flanges but the cremaster is rarely as elongate.

Anavitrinella is the most closely related genus to *Hypomecis* on the basis of larval and pupal characters. This is supported in the larva by the location and type of protuberances on the second abdominal segment and the chaetotaxy, and in the pupa by the structure of the cremaster and the type of

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showing internal morphology. 12, Lateral view showing circular muscles and tracheal trunk. 25×. 13, Ental view showing longitudinal muscles and glandular ducts. ×50. 14, Thoracic leg claw, 50×.

prespiracular furrow on the fifth abdominal segment. *Anacamptodes* and *Iridopsis* are also genera closely related to *Hypomecis*, but the second abdominal protuberances have different locations, and the cremaster has only two flanges at most; however, the chaetotaxy in some species is more similar to *Hypomecis umbrosaria* than to *Anavitrinella*. The *Hypomecis* adult, however, shows no clear affinity to any one particular genus.

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